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Original Article

Relationship between body mass index, waist circumference, waist hip ratio and erosive gastroesophageal reflux disease in a tertiary centre in Nigeria: A case control study

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ABSTRACT

Background: Gastro-oesophageal reflux disease (GERD) is a condition that develops when the reflux of stomach content causes troublesome symptoms with or without mucosa damage and or complications. GERD is believed to be evolving among blacks.
Objectives: The objective of this study was to look at the relationship of GERD to body mass index (BMI), waist circumference (WC), hip circumference (HC) and waist hip ratio (WHR) among patients with distal oesophageal erosive GERD and controls.
Methods: A case control study among patients with dyspepsia that had diagnostic upper gastrointestinal endoscopy. Patients with erosive GERD were grouped into cases while those without GERD were controls. GERD was graded using the Los Angeles classification. BMI, WC, HC and WHR were measured among cases and controls. Obesity was defined as BMI $\geq$ 30 kg/m^2 or WC $\geq$ 88 cm or $\geq$WHR 0.85 in females and BMI $\geq$ 30 kg/m^2 or WHR $\geq$ 0.9 or WC $\geq$ 102 cm for males. Data were analysed using descriptive and inferential statistics.
Results: A total of 160 subjects (80 cases and 80 controls) were analysed. Mean (SD) age for cases was 51.1 (±12.4) years and 50.1 (±13.7) years for controls. When cases with GERD were compared with controls; males were less likely to be obese, BMI < 30 kg/m^2, have normal WC, HC and WHR while females were more likely to be obese, BMI $\geq$ 30 kg/m^2 and have increased WC, and HC, ($p < 0.05$).
Conclusion: Central obesity is a risk factor for distal oesophageal erosive GERD among female Nigerians but not among males.

1. Introduction

Gastro-oesophageal reflux disease (GERD) is a condition that develops when the reflux of stomach content causes troublesome symptoms with or without mucosa damage and or complications. At upper gastro-intestinal endoscopy, GERD may be erosive (when there is visible erosions) or non-erosive (when there is no visible mucosa erosion). Heartburn and regurgitation are typical symptoms of reflux experienced by patients.[1,2] GERD is one of the most prevalent clinical conditions affecting the gastro-intestinal tract. Associated conditions that have been established to occur with GERD include the Zollinger Ellison syndrome (ZES) and connective tissue disease like scleroderma.[3] Central obesity has been fairly reasonably shown from studies outside Nigeria to be associated with GERD.[4–8] Among patients with obesity, studies have shown that central deposition of fat relates more to reflux symptoms than peripheral deposition of fat.[9] Other conditions that have been shown to be associated with GERD include pregnancy, cigarette smoking, and the use of drugs like the nitrates, calcium channel blockers, beta blockers and aminophylline.[10] Surgical destruction of the lower oesophageal sphincter or balloon dilatation also renders the gastro-esophageal valve incompetent.[10] Few studies have shown an association between GERD and central obesity in Nigeria and many of these are questionnaire based with only one or so that was based on diagnostic upper gastro-intestinal endoscopy.

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Therefore, the aim of this study was to assess the association between central obesity, defined by using the body mass index, waist circumference and waist-hip ratio and distal oesophageal erosive GERD among patients with dyspepsia undergoing upper gastrointestinal endoscopy in Ile-Ife, Nigeria

2. Methods

2.1. Study design and patients

This was a case control study involving patients diagnosed endoscopically with and without distal oesophageal erosive GERD (cases and controls). The study was conducted at the endoscopy unit of the Obafemi Awolowo University Teaching Hospital, Ile-Ife, Nigeria between March 2013 and December 2015. All patients with dyspepsia that had diagnostic upper gastrointestinal endoscopy were screened for distal oesophageal erosive GERD. Patients with distal oesophageal erosive GERD (cases) were age and sex matched with patients having dyspepsia but without distal oesophageal erosive GERD (controls). Participants were excluded if they smoked cigarette, were pregnant, or were on nasogastric tube prior to endoscopy. Patients with gastro-intestinal bleeding or gastric outlet obstruction or those with oesophageal or gastric cancer were also excluded. Ethical consideration involved taking informed consent from participants for the study. The Ethics and Research Committee of the hospital reviewed and approved the study with numbers IRB/IEC 00005422 & NHREC/27/02/2009a.

2.2. Procedures

A forward viewing gastroscope, Pentax FG-29W Model with a video monitor, was used. Cases and controls who gave written consents for the procedure had an endoscopic pre-medication of 10% xylocaine sprayed into the pharynx and a parenteral Midazolam or Diazepam of between 2.5 mg and 5 mg as well as 20 mg Hyosine to induce smooth muscle relaxation. Cases and controls thereafter had the procedure performed on them. The lower end of the oesophagus was visualized and any erosive mucosa break was noted and graded according to the Los Angeles (LA) grading system.[11] The LA grading system is detailed as follows: 1. LA Grade A, One (or more) mucosal break no longer than 5 mm that does not extend between the tops of two mucosal folds. II- LA Grade B, One (or more) mucosal break no longer than 5 mm that does not extend between the tops of two mucosal folds. III-LA Grade C, One (or more) mucosal break that is continuous between the tops of two or more mucosa folds, but involves less than 75% of the esophageal circumference. IV-LA Grade D, One (or more) mucosal breaks that involves at least 75% of the esophageal circumference. Thereafter, participants were allowed to recover after the procedure under observation.

2.3. Data collection

Socio-demographic characteristics and anthropometric data were taken for cases and controls and these included the body mass index (BMI), waist circumference (WC), hip circumference (HC) and waist-hip ratio (WHR). The value for the body mass index was calculated using the weight in kilogram divided by the square of the height in metres. Waist circumference was measured in centimetres at a midpoint between the lowermost rib and the anterior superior iliac spine with a non-stretch tape. Hip circumference was measured in centimetres at the widest portion of the hip. The value for the waist-hip ratio was obtained by dividing the waist circumference in metres by the hip circumference also in metres.

2.4. Statistical analysis

Data were entered into SPSS version 20 software and analysed using descriptive and inferential statistics. Frequencies and means were generated. Cases and control groups were divided into two groups of obese and normal patients using the body mass index (BMI), waist circumference (WC) and the waist-hip ratio (WHR) according to the World Health Organisation criteria.[12,13] Result of the division was categorised into the various grades of GERD for cases. Mean values of BMI, WC, HC and WHR were calculated for both cases and controls. Categorical variables were compared using the Chi-square test, while continuous variables were compared using a Student's *t* test. Significant level was put at $p \leq 0.05$.

3. Results

3.1. Participants' characteristics

A total of 160 participants completed the study, comprising 80 cases with distal oesophageal erosive GERD and 80 controls without distal oesophageal erosive GERD (Table 1). The cases represented 16% among 500 patients that had upper gastro-intestinal endoscopy during the study period in the gastro-intestinal unit of the hospital alone. Majority of the cases and controls were within the age group of 41–60 years. The age of the index cases ranged from 21 to 77 years with a mean (SD) of 51.1 (±12.4) years, while the controls ranged from 22 to 78 years with a mean (SD) of 50.1 (±13.7) years. There were 29 males and 51 females for both cases and controls with an M: F ratio of approximately 1:2. The occupations of the cases with distal oesophageal erosive GERD were civil servants 36 (45%), artisans 5 (6.3%), traders 26 (32.5%) and the unemployed 13 (16.3%). Those of the controls were civil servants, 38 (47.5%), artisans 9 (11.3%), traders 16 (20%) and the unemployed 17 (21.3%).

3.2. Anthropometric indices of participants and GERD

All male cases with distal oesophageal erosive GERD had BMI below 30 kg/m^2 and with a higher proportion of 44.8% in the LA grade A. The proportion of cases reduced progressively in the LA grades to 13.8% in the grade D category (Table 2). The proportion of males with GERD in the WHR $\geq$ 0.9 category was more than those in the WHR < 0.9 category. Again, a greater proportion of these cases (45.8%) were in LA grade A than other grades. On the other hand, male cases with GERD and WC < 102 cm were in higher proportion than those with WC $\geq$ 102 cm (Table 2).

Females with GERD who had WC > 88 cm, or WHR > 0.85, had higher grades of GERD than women who did not reach these thresholds of WC or WHR. On the other hand, most women with GERD and a BMI > 30 kg/m^2 had GERD in the LA grades of C and D. Women with GERD and a BMI < 30 kg/m^2 however had GERD mostly in the LA grades of A and B respectively (Table 2).

When the cases of GERD were compared with controls, the proportion of male cases with GERD and BMI < 30 kg/m^2 was higher than those with BMI > 30 kg/m^2, though this did not reach a statistical significance, $p > 0.05$. There was no statistically significant difference in the proportion of male cases that were obese and had GERD, based on their WC and WHR and those that were not obese compared with controls, $p > 0.05$. There was a significantly higher number of females with GERD on endoscopy with obesity, defined by BMI or WC, compared with controls, $p < 0.05$ (Table 3).

The mean values of BMI, WC, WHR and HC among male cases compared with controls were not statistically significant ($p > 0.05$), while on the other hand, the mean values of the BMI, WC and HC for female cases compared with controls were all sta-

Table1
Baseline characteristics of patients and controls.

Participants	Variables Age group (yrs)	Cases No (%)	Controls No (%)	X^2	P value
All patients	21–40	16 (43.2)	21 (56.8)	0.886	0.642*
	41–60	46 (52.2)	42 (47.7)		
	>60	18 (51.4)	17 (48.6)		
Males	21–40	8 (42.1)	11 (57.9)	1.886	0.389*
	41–60	13 (61.9)	8 (38.1)		
	>60	8 (44.4)	10 (55.6)		
Females	21–40	8 (44.4)	10 (55.6)	1.008	0.604*
	41–60	33 (49.3)	34 (50.7)		
	>60	10 (58.8)	7 (41.2)		
BMI kg/m^2	<18.5	4 (50)	4 (50)	10.166	0.071*
	16.5–24.9	23 (37.1)	39 (62.9)		
	25–29.9	27 (51.9)	25 (48.1)		
	30–34.9	16 (64)	9 (36)		
	35–39.9	9 (75)	3 (25)		
	>40	1 (100)			
Occupation	Civil servants	36 (51.4)	38 (46.6)	14.606	0.002*
	Artisans	5 (23.8)	16 (76.2)		
	Traders	26 (74.3)	9 (25.7)		
	Unemployed	13 (56.7)	17 (43.3)		

* Pearson's Chi Square.

Table 2
Grades of GERD, WC, WHR and BMI of patients group.

Variables	GERD Grade A N (%)	GRADES Grade B N (%)	Grade C N (%)	Grade D N (%)	X^2	P value
Males (29)						
BMI < 30 kg/m^2	13 (44.8)	8 (27.6)	4 (13.8)	4 (13.8)		
BMI ≥ 30 kg/m^2	0	0	0	0		
WHR < 0.9	2 (40)	2 (40)	1 (20)	0	2.004	0.572**
WHR ≥ 0.9	11 (45.8)	6 (25)	3 (12.5)	4 (16.7)		
WC < 102 cm	11 (44)	6 (24)	4 (16)	4 (16)	3.109	0.375*
WC ≥ 102 cm	2 (50)	2 (50)	0	0		
Females (51)						
BMI < 30Kg/m^2	9 (36)	5 (20)	5 (20)	6 (24)	1.350	0.717*
BMI ≥ 30Kg/m^2	6 (23.1)	5 (19.2)	8 (30.7)	7 (26.9)		
WHR < 0.85	4 (50)	2 (25)	0	2 (25)	5.496	0.139*
WHR ≥ 0.85	12 (27.9)	8 (18.6)	13 (30.2)	10 (23.3)		
WC < 88 cm	3 (27.2)	3 (27.2)	1 (9.1)	4 (36.4)	3.195	0.363*
WC ≥ 88 cm	13 (32.5)	7 (17.5)	12 (30)	8 (20)		

* Pearson's Chi Square.
** Likelihood ratio.

Table 3
BMI, WC, WHR and SEX of cases and controls.

Variables	Cases No (%)	Controls No (%)	X^2	P value
Males (29)				
BMI < 30 kg/m^2	29 (52.7)	26 (47.3)		0.237**
BMI ≥ 30 kg/m^2	0	3 (100)		
WHR < 0.9	5 (35.7)	9 (64.3)	1.506	0.220*
WHR ≥ 0.9	24 (54.5)	20 (45.5)		
WC < 102 cm	25 (50)	25 (50)		1.000**
WC ≥ 102 cm	4 (50)	4 (50)		
Females (51)				
BMI < 30 kg/m^2	25 (37.3)	42 (62.7)	12.124	0.0001*
BMI ≥ 30 kg/m^2	26 (74.3)	9 (25.7)		
WHR < 0.85	8 (33.3)	16 (66.7)	3.487	0.062*
WHR ≥ 0.85	43 (55.1)	35 (43.7)		
WC < 88 cm	11 (51.2)	22 (44.9)	5.420	0.020*
WC ≥ 88 cm	40 (58)	29 (42.0)		

* Pearson's Chi square.
** Fischer's exact test.

Table 4
Mean values of anthropometric indices of Cases and controls.

Variables	Cases	Controls	T test	P value
Males (29)				
Mean BMI kg/m^2	24.2 ± 3.7	23.7 ± 4.1	−0.554	0.582
Mean WC	85.8 ± 15.9	86.7 ± 13.6	−0.306	0.819
Mean WHR	0.97 ± 0.14	0.93 ± 0.07	−0.567	0.206
Mean Hip Circ**	88.94 ± 16.22	92.02 ± 10.34	0.860	0.394
Females (51)				
Mean BMI	29.45 ± 6.21	25.93 ± 5.22	−0.3096	0.003*
Mean WC	96.83 ± 12.92	89.12 ± 12.47	−3.068	0.003*
Mean WHR	0.90 ± 0.078	0.89 ± 0.11	−0.567	0.572
Mean Hip circ**	107.16 ± 11.88	99.61 ± 12.27	−3.158	0.002*

Keys:
* Statistically significant.
** Mean hip circ = Mean hip circumference.

tistically significant ($p < 0.05$). The mean values of WHR between cases and controls were not statistically significant for females, $p > 0.05$ (Table 4).

4. Discussion

In this study of patients with distal oesophageal erosive GERD, only eighty cases were seen over a period of two years and nine months in the gastro-intestinal unit alone. This may imply that the condition is not common among Nigerians. This finding agrees with previous reports from Nigeria that showed that the prevalence of the disease is low in the country and even among people from Africa living in Europe.[14–16] There is a study however that reported that the most common endoscopic finding among patients with dyspepsia in the densely populated city of Lagos in Nigeria was GERD.[17] This is in contrast with the findings in this semi-urban town of the same Southwest zone of Nigeria. The reason for the difference may be due to lifestyle and affluence associated with the urban centre. Urban cities may probably have more cases of people with central obesity and the diet of the people may also play a role. Affluence and western life style have been shown to influence the occurrence of GERD among low risk population like Nigeria.[18]

The prevalence of GERD in other parts of Africa varies from 24% in Tunisia to 47% among patients with GERD symptoms in Sudan.[19,20]

Affluence may play a more central role as has been shown in this study of cases with GERD in which central obesity was a risk factor among females. The reason why females were more affected is not clear for now, but may be related to hormonal factors.[21,22] The female hormones, oestrogens, may actually encourage tendency to develop central obesity, besides sedentary lifestyle and leptin released from fat deposits.

GERD was found mainly among civil servants, followed by traders. This differs slightly from the study by Akere et al. in another urban setting of Southwest Nigeria. The study found GERD mainly among traders and students. This, however, was a questionnaire based study and would have included cases having both erosive and non-erosive distal oesophageal GERD. Despite these differences, the study found GERD to be common among females similar to the findings in this study.[23]

GERD has been shown to be associated with central obesity among the white population, and they also have the severe forms of the disease.[18] In our study, majority of the cases had the mild forms of GERD. This supports previous reports in the literature.[18,24] It may thus point to the fact that GERD is evolving among people from Africa, a fact that has been raised among researchers in Kenya.[25] Among people from Africa, few studies have shown an association between central obesity and GERD. A study from Southwest Nigeria reported a weak association between central obesity and GERD.[23] However, this was a questionnaire based study.

Another study from Eastern Nigeria reported a positive association between GERD and central obesity using the BMI among patients that had diagnostic upper gastro-intestinal endoscopy.[24] Our study has however gone a step higher to show that GERD is actually associated with increased body mass index and waist circumference (BMI & WC) among female patients in our environment. Body mass index, waist circumference and waist hip ratio among males were not significantly associated with the occurrence of GERD in our study. The reason for this may be due to the small sample size of males in our study. Another reason may be the influence of leptin released from fat deposits. The males in this study were not obese based on the BMI. Obesity, particularly the central type with increased leptin levels have been associated with clinically and endoscopically severe GERD.[25] WHR was not associated with GERD among female cases compared with controls, though WC was. It may be that female cases with GERD equally had high HC, as shown by the mean value of HC among cases and controls which was statistically significant ($p < 0.05$).

Among people with obesity having GERD, abdominal fat is implicated as the cause of the disease because cytokines are released from the fat deposits that relax the gastro-oesophageal sphincter.[5,21] Our study has demonstrated that accumulation of abdominal fat in females in our environment is associated with GERD as has been reported among affluent Whites in the western countries.[21] The mechanism for this may be that patients with central obesity may develop increased intra-abdominal pressure leading to GERD. GERD itself may develop at varying stages of fat accumulation depending on genetic predisposition.

The mean age of patients with GERD in our study was lower than that from western countries and this agrees with the report by Loffeld et al.[16] which showed that the mean age among Black immigrants with GERD was about a decade lower than that among Dutch patients with GERD. The lower mean age in our study also agrees with another report from Southwest Nigeria.[26]

4.1. Limitations of the study

This was a hospital based study on distal oesophageal erosive GERD; some patients without erosive GERD may have had a non erosive reflux disease (NERD).

5. Conclusion

GERD may be evolving among Nigerians. The disease tends to be in the early grades in our environment and appears more common among women than men. Central obesity as defined by the

body mass index and waist circumference are clear risk factors among women in Nigeria.

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Conflict of interest

We the authors declare no conflict of interest.

Contributors' list

AO was involved in the conception and design as well as writing of this manuscript, OSA did the statistical analysis, IO read and approved the final version of the article, NDA was involved in the conception and design of this article. KAO was involved in the writing of the manuscript. All authors approved the final version of the manuscript.

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